Heat Morbidity Surveillance Using Hospital Discharge Data

2012 Data

Maricopa County Department of Public Health

Division of Disease Control

Office of Epidemiology

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Contents

Background

Throughout the year, Maricopa County experiences extremely hot temperatures that can have a negative impact on the health of its residents and visitors. Due to the extreme temperatures, the Maricopa County Department of Public Heath (MCDPH) Office of Epidemiology has been using surveillance practices to track climatological data and heat-associated deaths in the county to gain a better understanding of the full impact.

Beginning in 2012, the Office of Epidemiology expanded these efforts to include heat-related illness (HRI) surveillance which will assist in improving the Department's response to the chronic environmental heat experienced in Maricopa County. Additionally, by expanding the heat surveillance system, opportunities to learn more about the effects of heat in Maricopa County and ways to best use heat surveillance will become more evident.

Methodology

Hospital discharge data (HDD) contains emergency department (ED) and inpatient (IP) hospital visits for all non-federal (Veteran's Affairs, Indian Health Service) hospitals in Maricopa County. Heat related illness visits were identified using selected International Classification of Diseases-9th Revision (ICD-9) codes. Selection of ICD-9 codes was made using a combination of literature review searches of other heat morbidity surveillance systems along with the definition provided by the Council of State and Territorial Epidemiologists (CSTE) for hospitalizations due to heat. **Figure 1** lists the ICD-9 codes that were included and excluded in this query. Selected visits were then put into four categories according to the following criteria:

- Heat Related Illness: the presence of one or more of the inclusion ICD-9 codes (see Figure 1) listed in any of the diagnosis or injury variables in the HDD.
    - The SAS program scans a record to see if it contains a code for a primary diagnosis (DX) of heat. If it does, the record is coded as having a primary DX heat. If not, the program will then scan the record to see if any of the 24 secondary codes are heat related. If yes, then the person is coded as having a secondary diagnosis of heat related illness. If not, the program then checks the 6 injury codes to see if the record was coded as having a heat related injury and if yes, the person is coded as having a heat related illness. If no, the record is coded as not having any type of heat related illness and is dropped from analysis.
- Primary DX Heat: Cases where the primary reason for hospitalization or emergency department (ED) visit is heat related.
- Secondary DX Heat: Cases where heat is listed as one of the up to 24 secondary causes for hospitalization or ED visit.
- Heat Injury: Heat is mentioned as the cause of injury for the hospitalized person. There are up to 6 injury diagnoses per record in addition to the primary diagnosis.

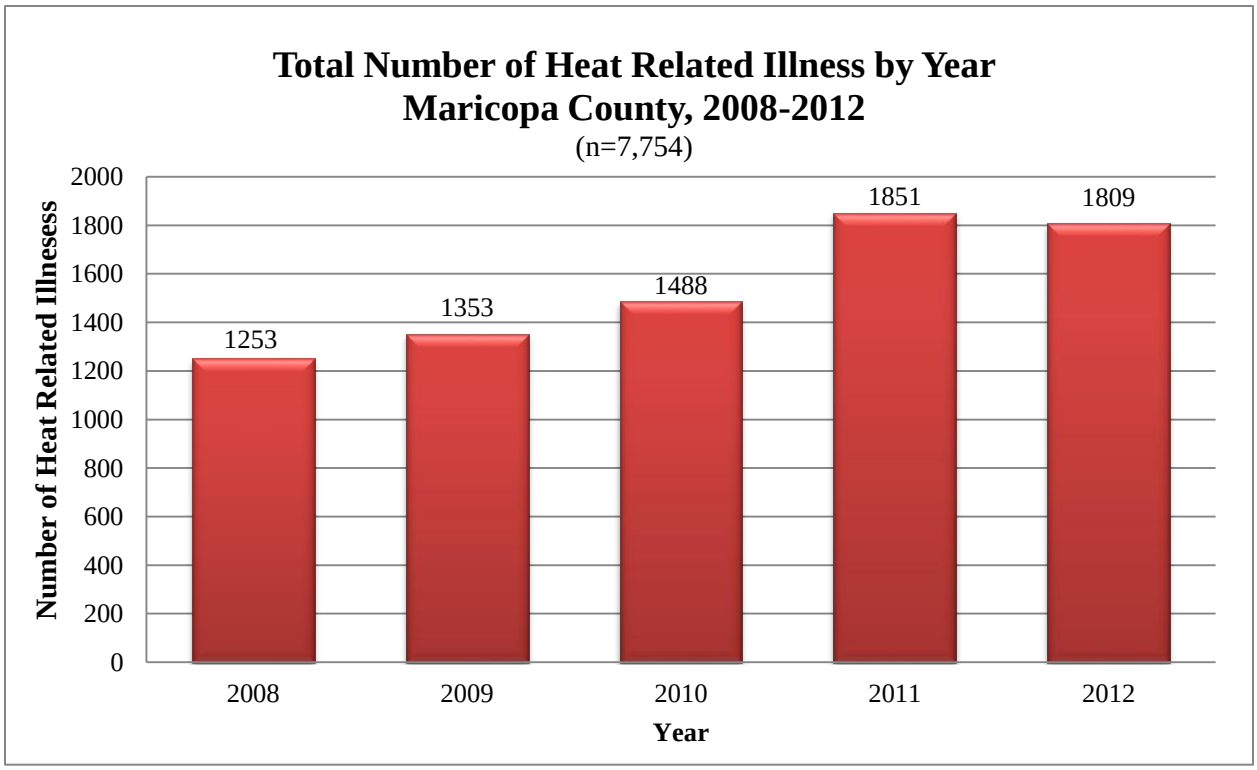
Figure 1: Heat-Related Hospital Discharge Data ICD-9 Codes	
992	**Effects of heat and light**
992.0	Heat stroke and sunstroke Heat apoplexy Heat pyrexia Ictus solaris Siriasis Thermoplegia Codes to identify associated complications of heat stroke such as:
780.01-780.09	Alterations of consciousness
995.93-995.94	Systemic inflammatory response syndrome
992.1	Heat syncope Heat collapse
992.2	Heat cramps
992.3	Heat exhaustion, anhydrotic Heat prostration due to water depletion Excludes that associated with salt depletion (992.4)
992.4	Heat exhaustion due to salt depletion Heat prostration due to salt (and water) depletion
992.5	Heat exhaustion, unspecified Heat prostration NOS
992.6	Heat fatigue, transient
992.7	Heat edema
992.8	Other specified heat effects
992.9	Unspecified
E900	**Excessive heat**
E900.0	Due to weather conditions Excessive heat as the external cause of: Ictus solaris Siriasis Sunstroke
EXCLUDED	
940.0-949.5	Burns
705.0-705.9	Diseases of sweat glands due to heat
995.86	Malignant hyperpyrexia following anesthesia
692.71, 692.76-692.77	Sunburn
E900.1	Of man-made origin (heat in boiler room, drying room, factory, furnace room, generated in transport vehicle, kitchen)
E900.9	Of unspecified origin
276.5	Volume depletion
276.50	Volume depletion, unspecified
276.51	Dehydration
276.52	Hypovolemia - Depletion of volume of plasma
705.1	Prickly heat
708.2	Urticaria due to cold and heat

Results

All results represent occurrences of heat related illness in Maricopa County hospitals (n=1,809); many of these individuals are non-residents of Maricopa County. However, rates were calculated using Maricopa County residents only and exclude any out of jurisdiction cases or cases with unknown county of residence.

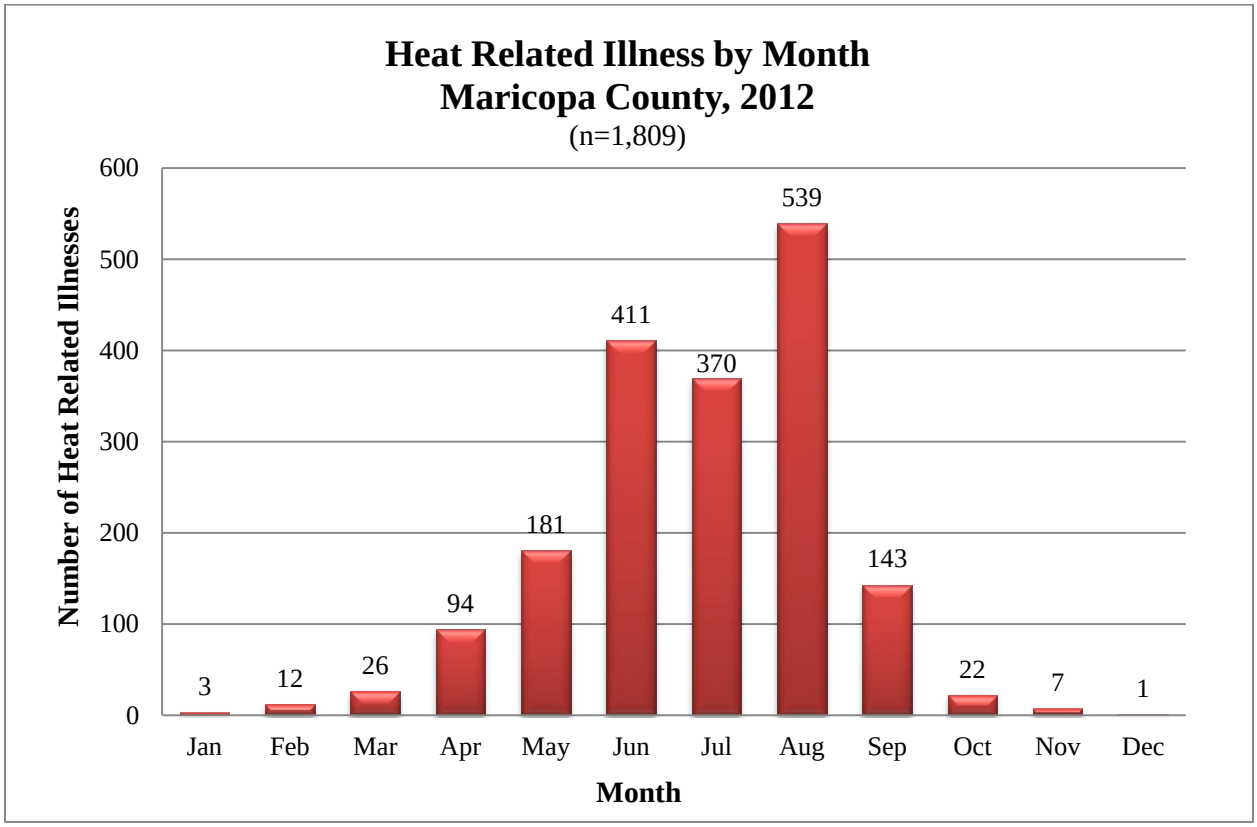
Introduction

Graph 1



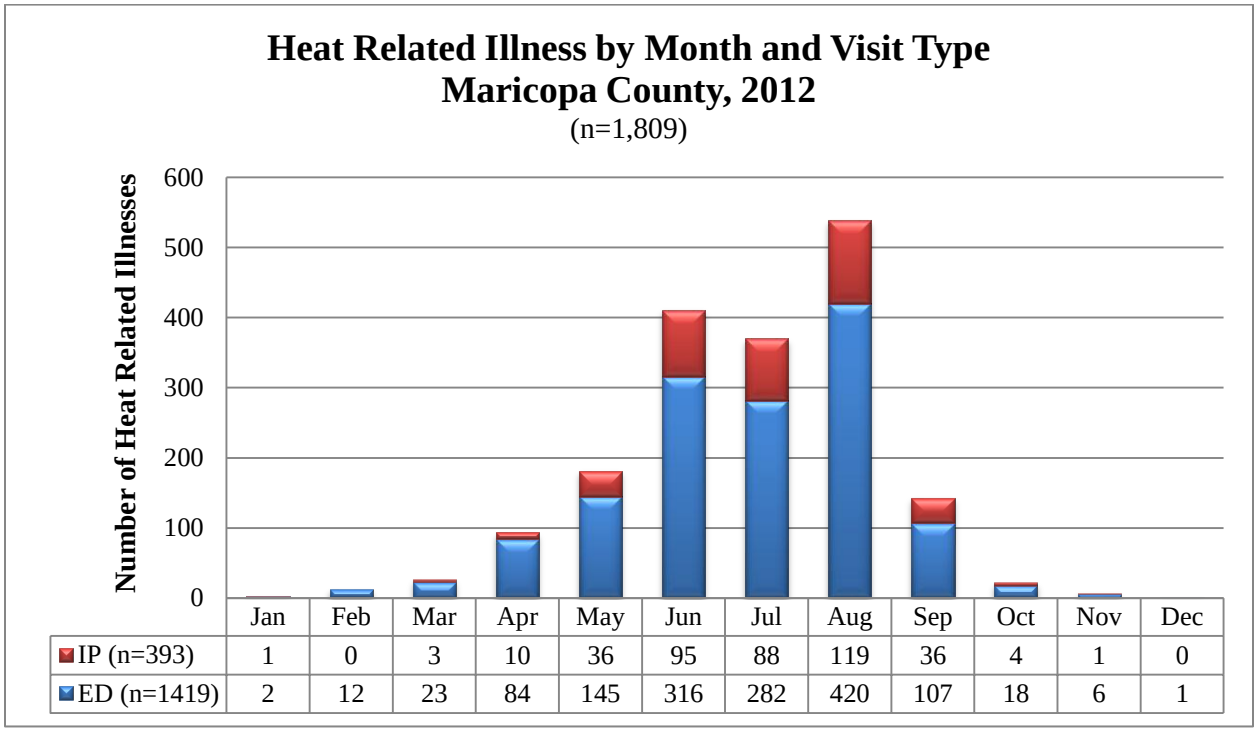
The number of heat related illnesses increased steadily from 2008-2012, with the highest percentage of heat related illnesses occurring in 2011 (24%).

Graph 2



The number of heat related illnesses dramatically increased June through August, with the month of August experiencing the highest percent of heat related illnesses (30%).

Graph 3

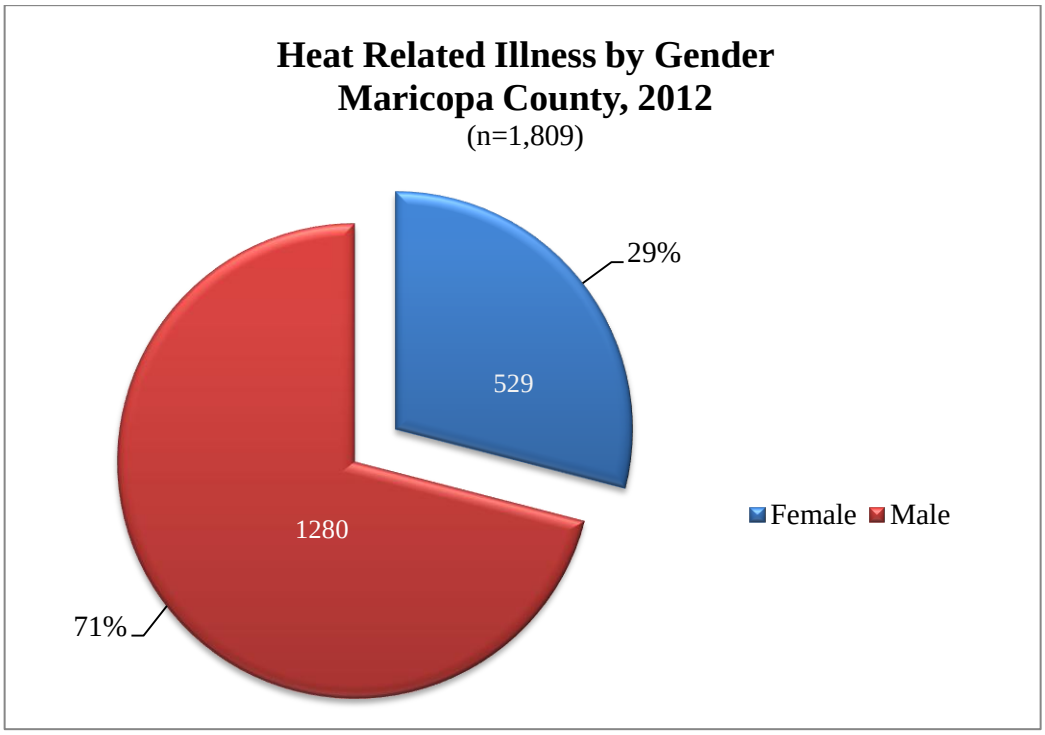


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
IP (n=393)	1	0	3	10	36	95	88	119	36	4	1	0
ED (n=1419)	2	12	23	84	145	316	282	420	107	18	6	1

Emergency department (ED) visits for heat related illness were consistently higher than in-patient (IP) visits, particularly during the month of August which accounted for 29.7% of all visits combined, and 23.2% of emergency department visits.

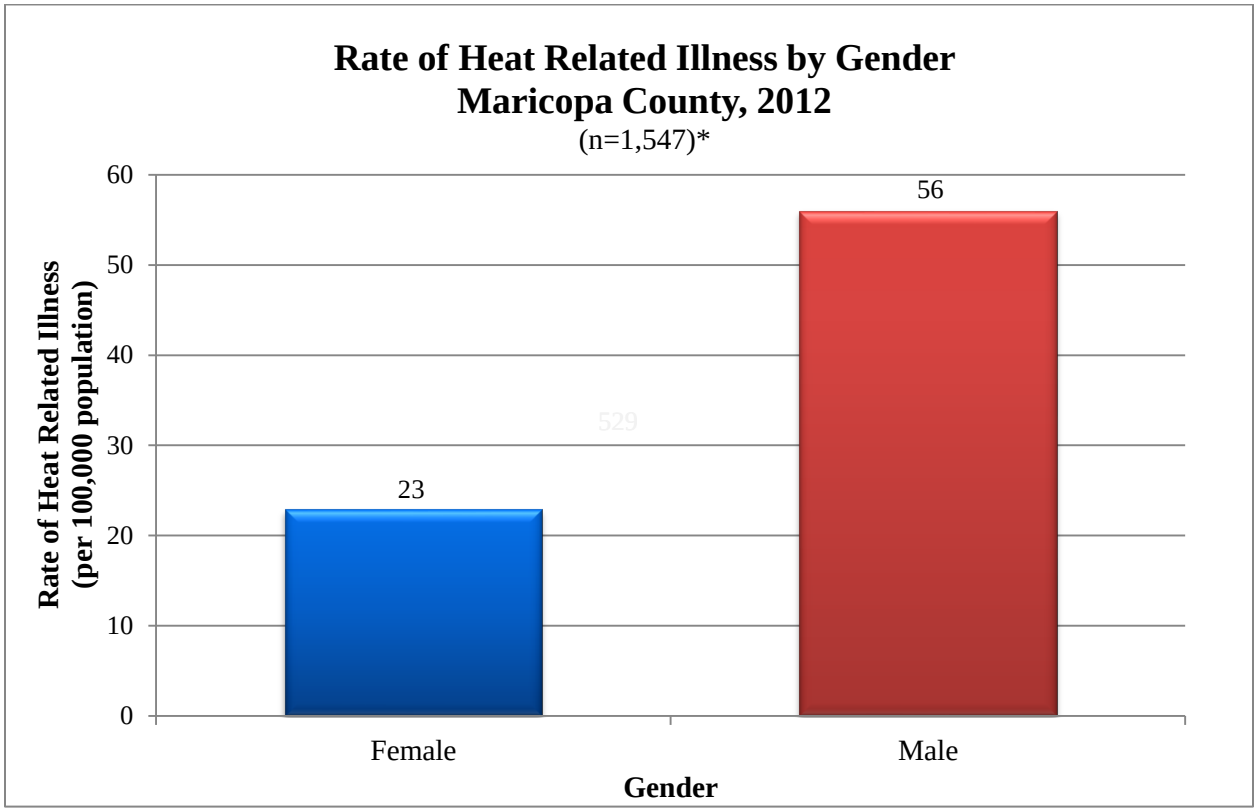
Demographics

Graph 4



In 2012, heat related illnesses affected males more than females (71% vs. 29%) The ratio of heat related illness between males to females is 2.4:1, meaning males are over two times more likely to experience heat related illness than females.

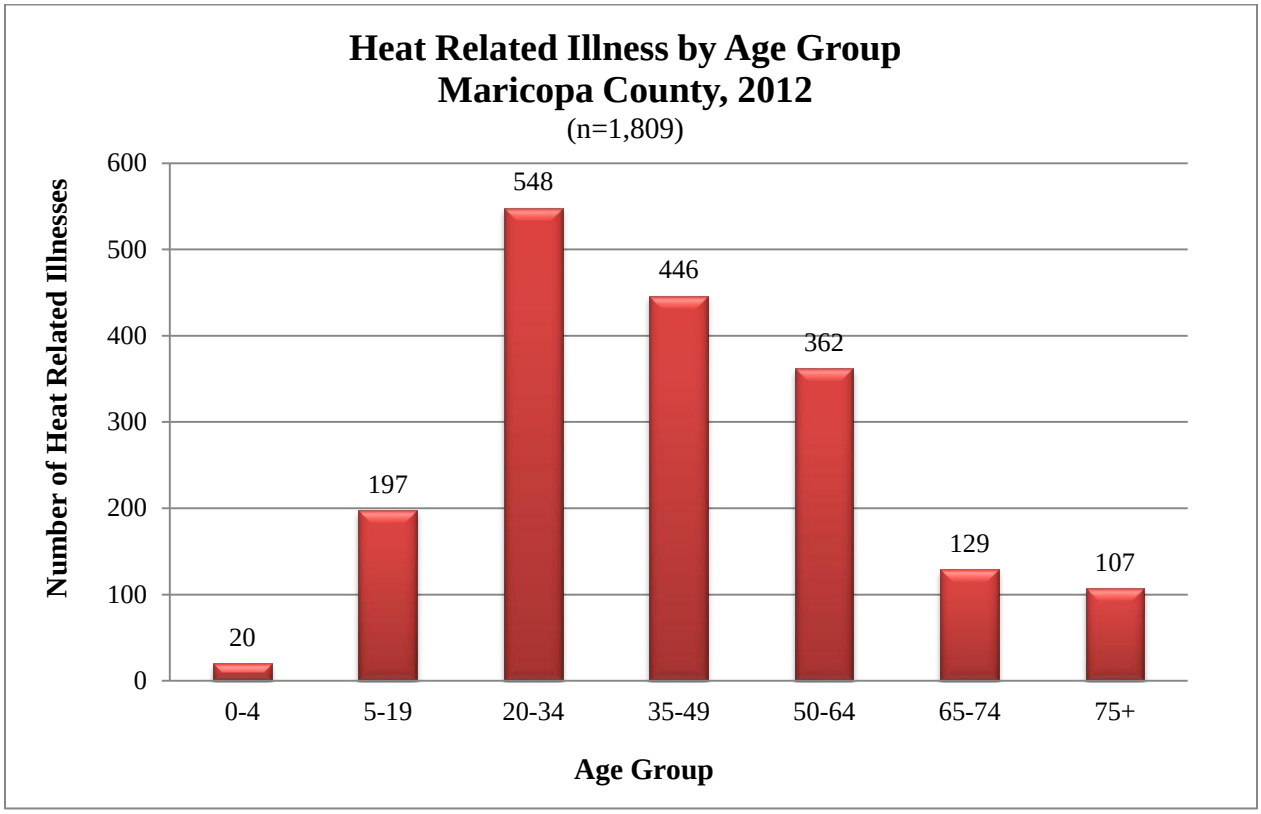
Graph 5



*Rates for Maricopa County residents; unknown values excluded

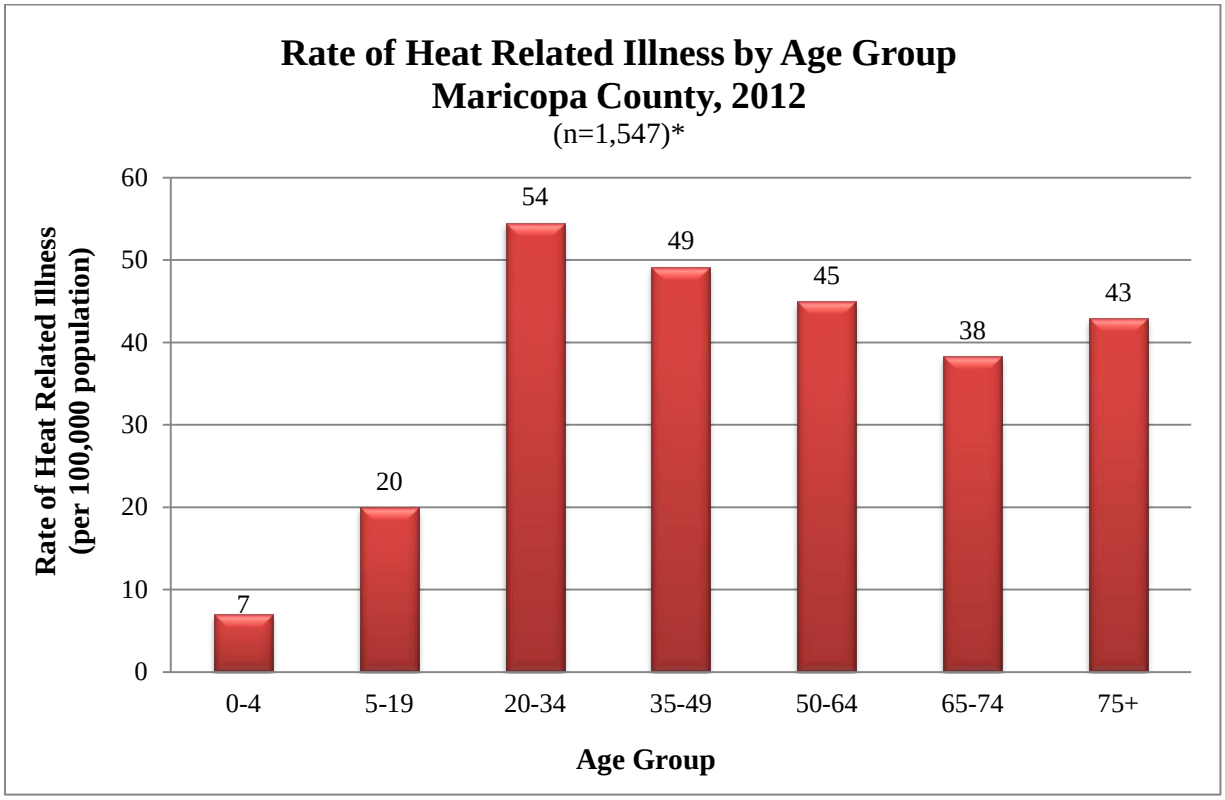
In 2012, the rate of heat related illness was consistently higher in males (56.0) than females (22.8). This is consistent with the number of heat related illness shown in Graph 4.

Graph 6



Over half of the heat related illnesses in 2012 were experienced by individuals between the ages of 20-49, with the highest percent of illnesses occurring between the ages of 20-34 (30%).

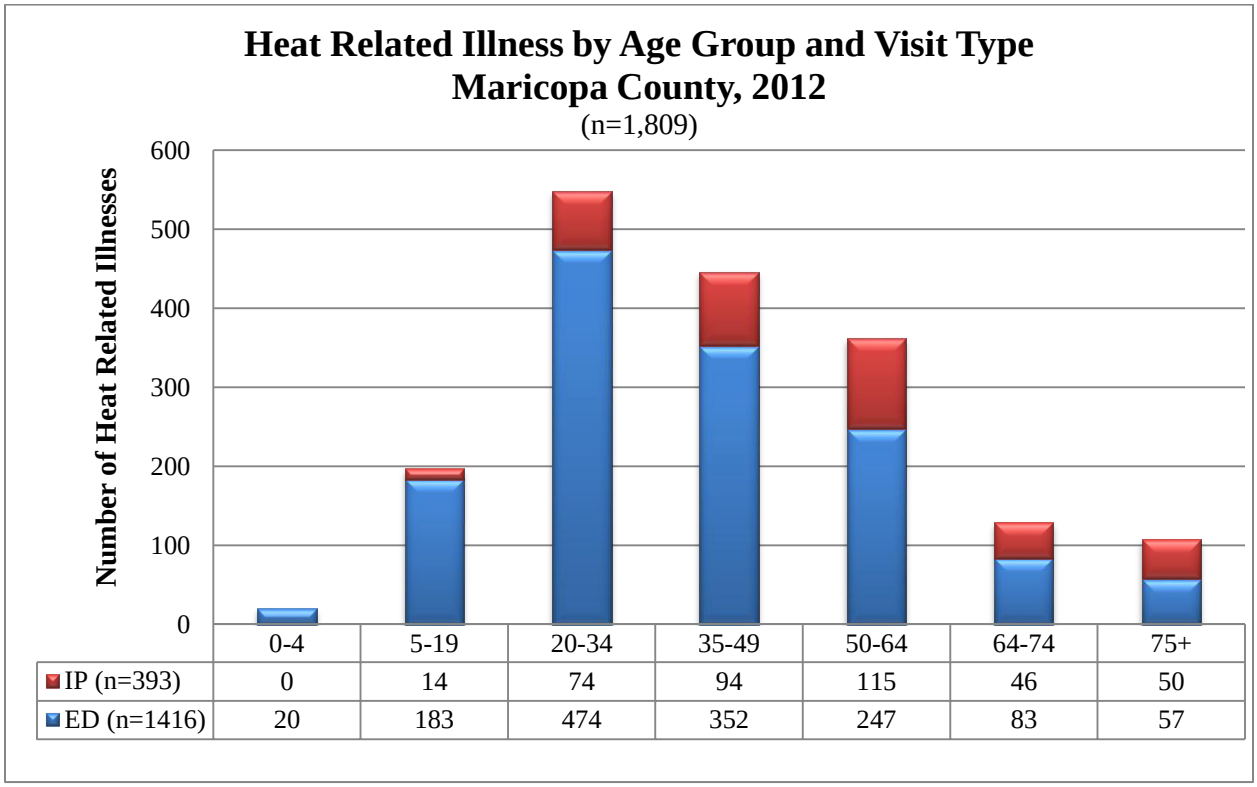
Graph 7



*Rates for Maricopa County residents; unknown values excluded

In 2012, the rate of heat related illness was consistently higher between the ages of 20-64, with the rates being the highest amongst those age 20-34 (54.5).

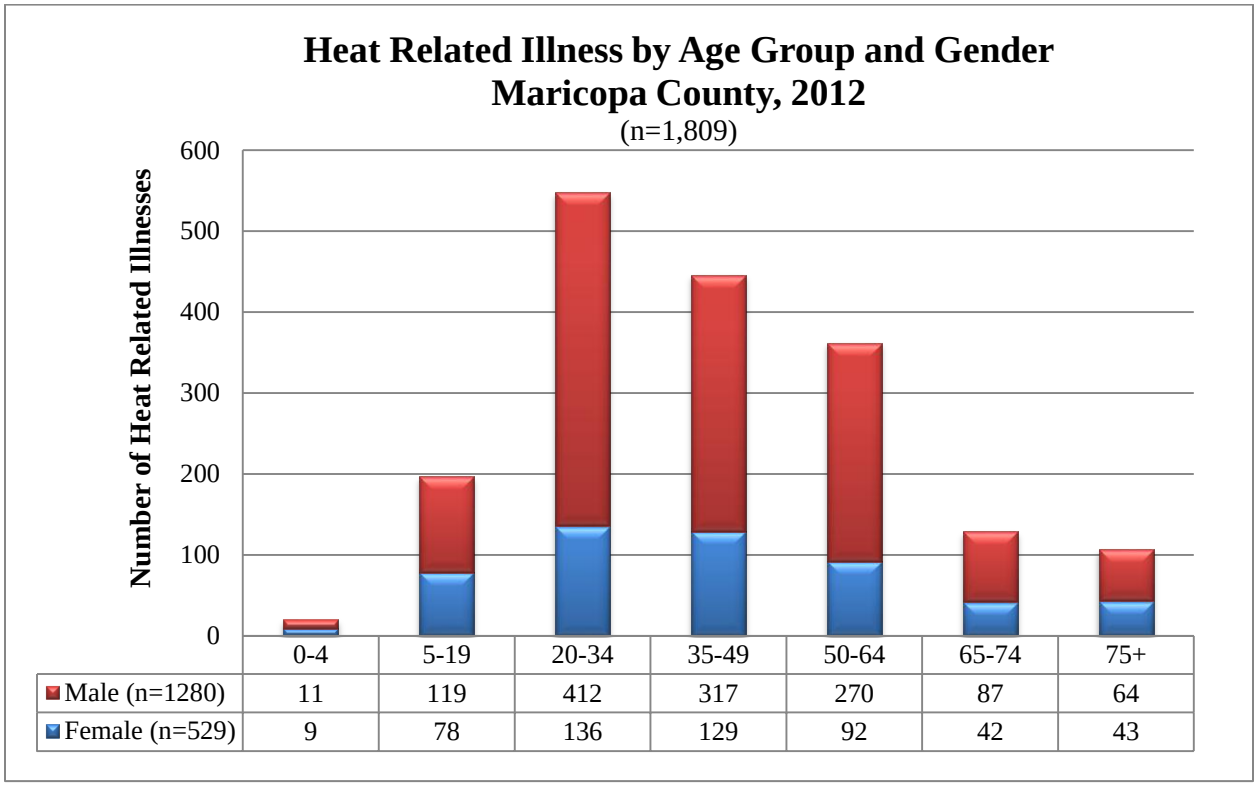
Graph 8



	0-4	5-19	20-34	35-49	50-64	64-74	75+
IP (n=393)	0	14	74	94	115	46	50
ED (n=1416)	20	183	474	352	247	83	57

Emergency department (ED) visits for heat related illnesses were consistently higher than in-patient (IP) visits, particularly, amongst those ages 20-34 who accounted for 30% of all visits combined, and 33% of emergency department visits.

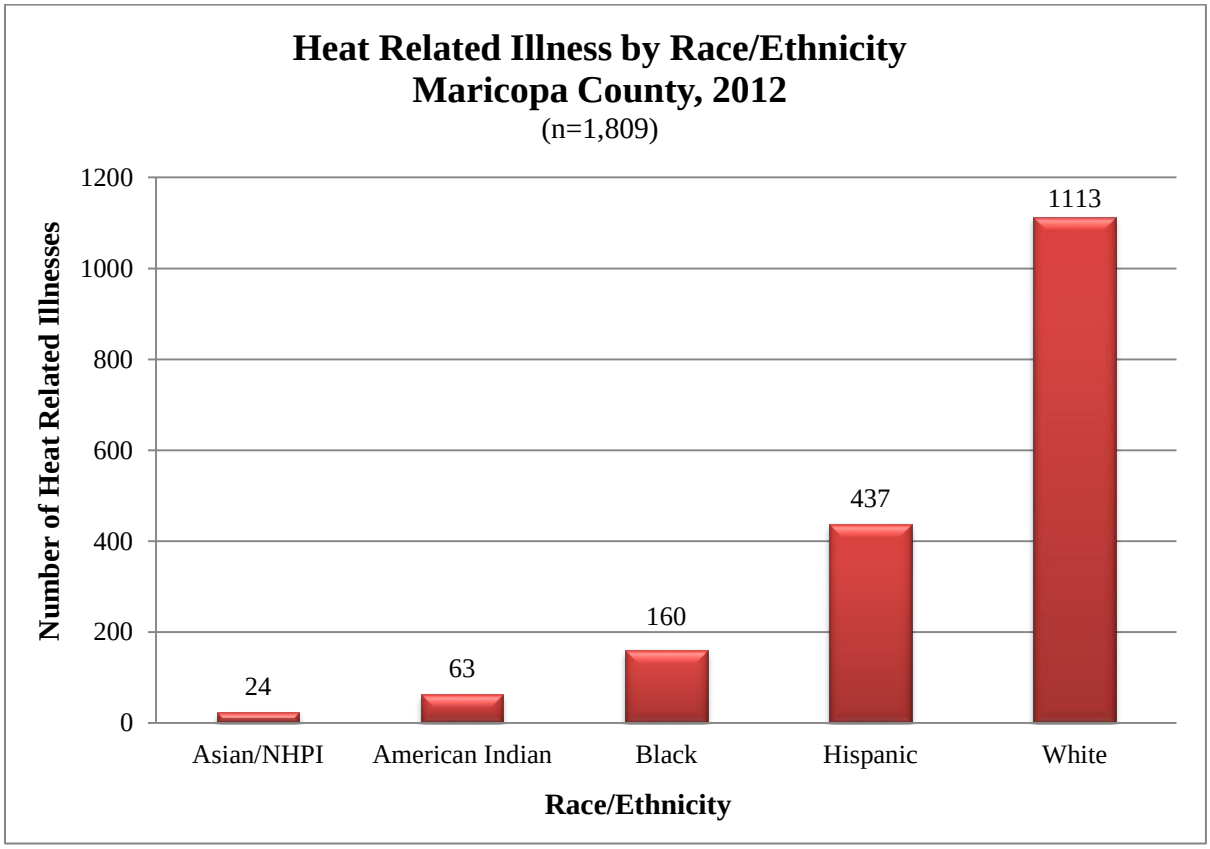
Graph 9



	0-4	5-19	20-34	35-49	50-64	65-74	75+
Male (n=1280)	11	119	412	317	270	87	64
Female (n=529)	9	78	136	129	92	42	43

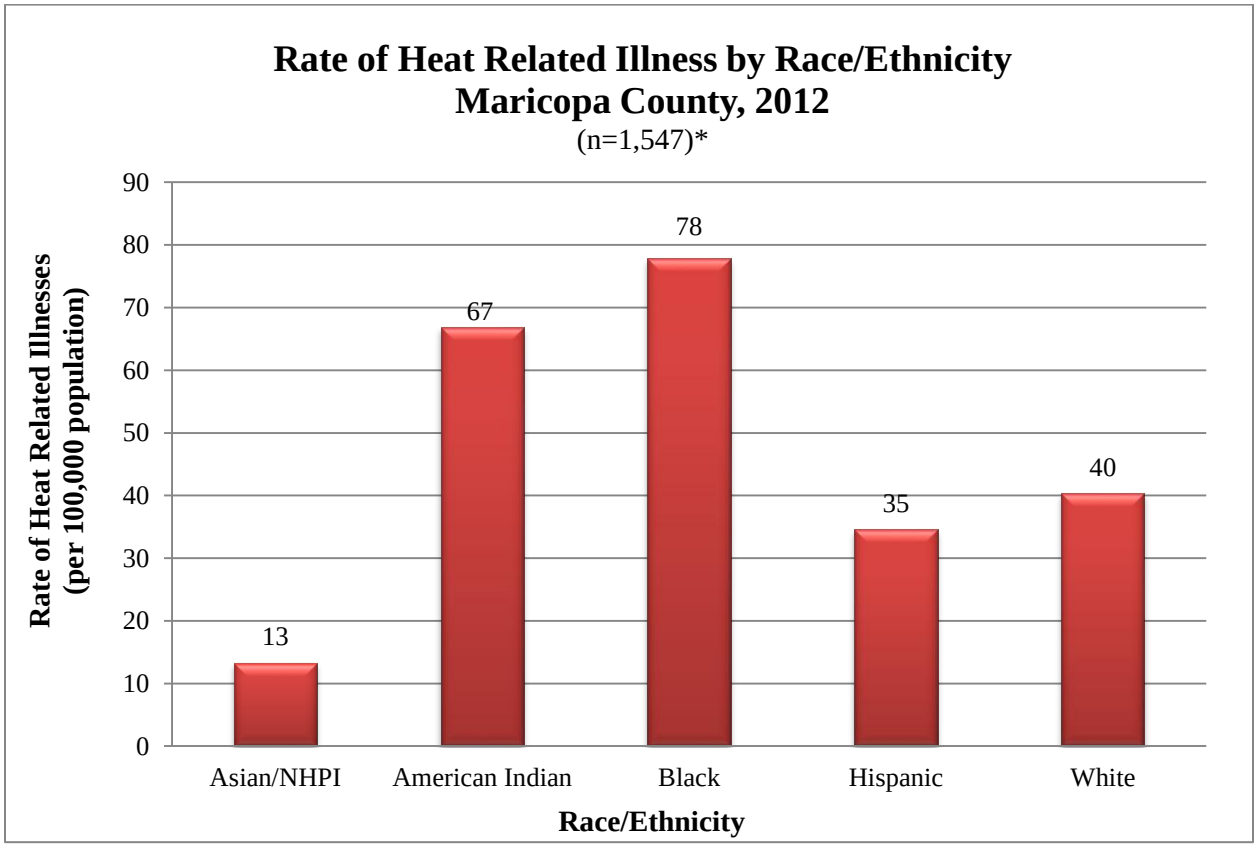
Heat related illnesses were consistently higher among males than females, particularly for males ages 20-34 who accounted for 22.8% of all heat related illness.

Graph 10



In 2012, Whites experienced the highest percent of heat related illnesses at 61.5%, followed by Hispanics at 24.2%.

Graph 11

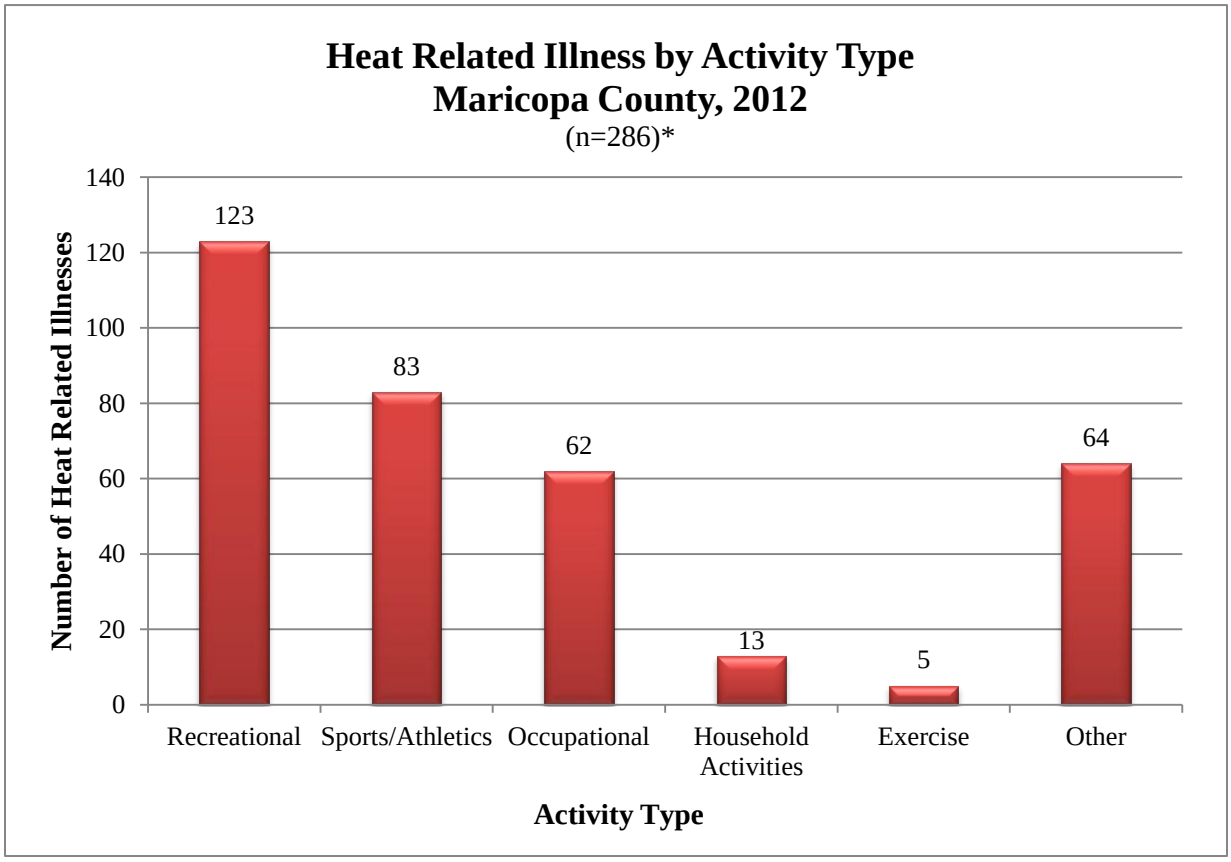


*Rates for Maricopa County residents; unknown values excluded

While the total number of heat related illnesses was highest among Whites, the rate of incident was highest amongst Blacks and American Indians.

Injury Characteristics

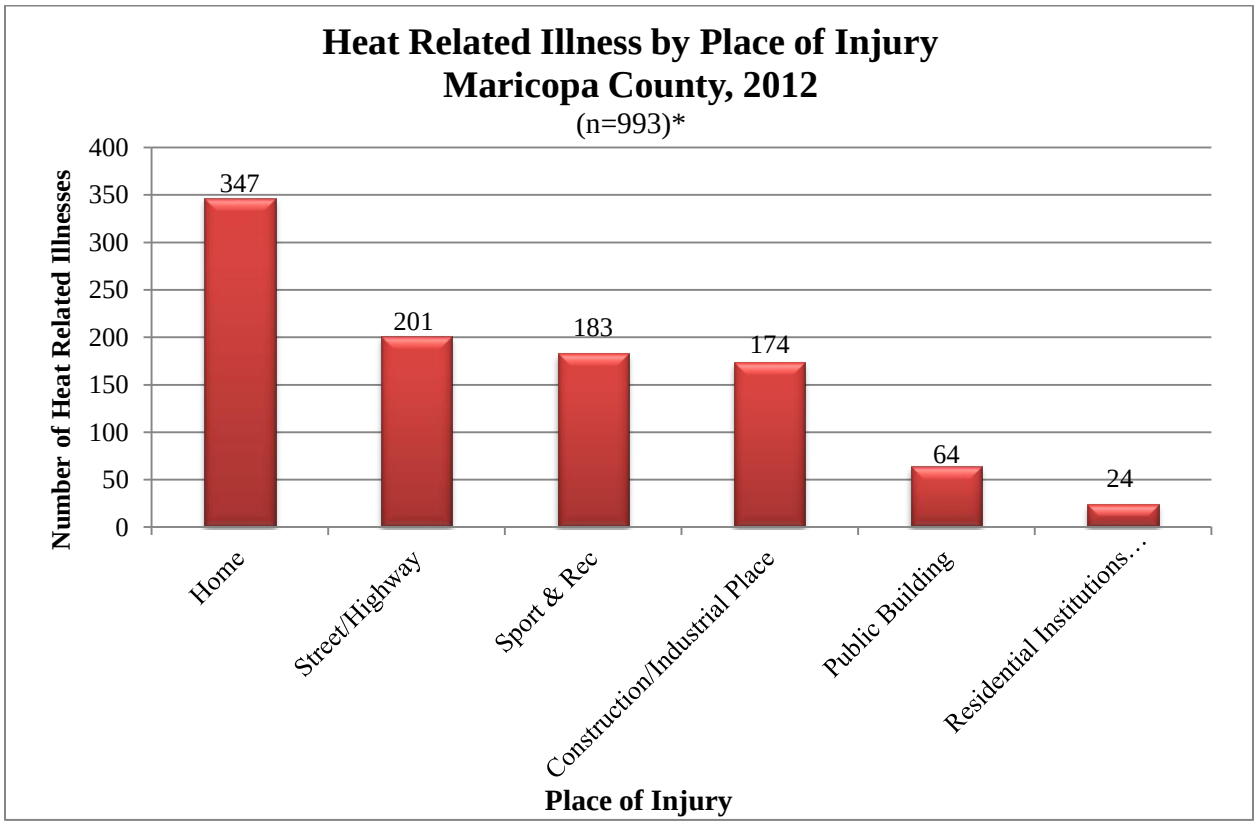
Graph 12



*Excludes 1,459 cases where no activity was listed.

In 2012, heat related illnesses were highest among recreational activities (35%), followed by sport/athletic activities (24%).

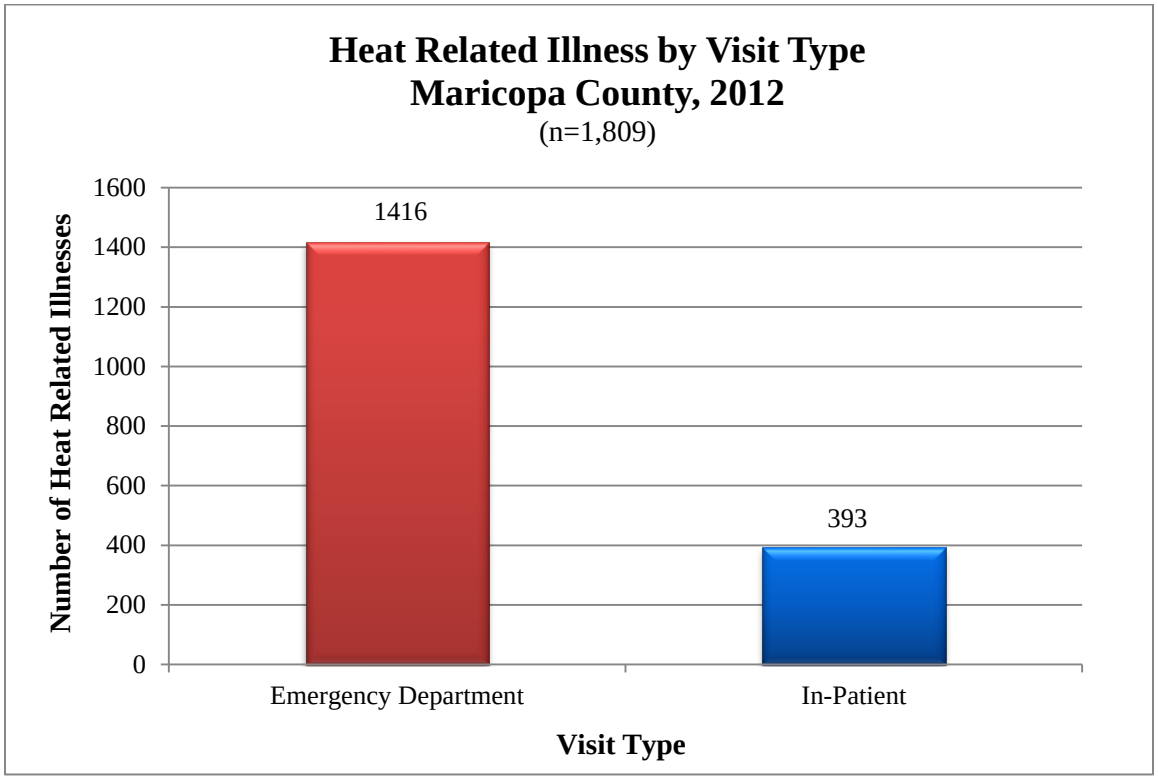
Graph 13



*Excludes 816 unknown cases

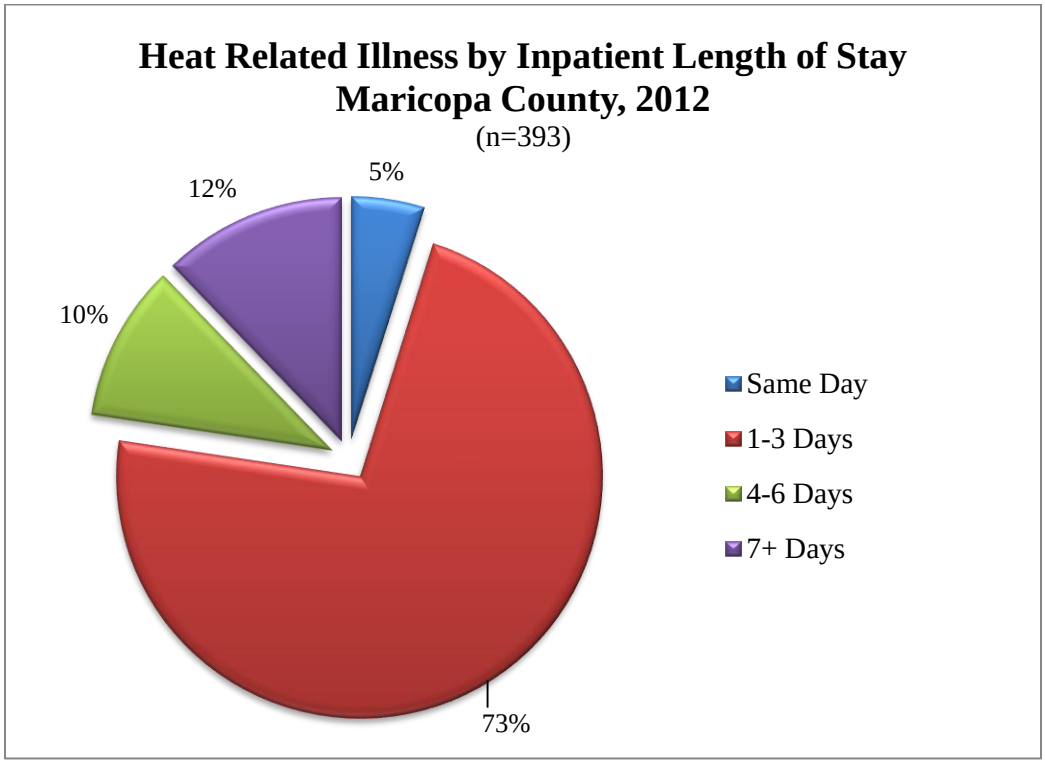
From those cases in 2012 where place of injury was known, a large proportion of heat related illnesses occurred at the home (26%). Different from Graph 12, this graph looks at where the injury took place vs. what type of activity was taking place at the time of the injury. The activity taking place does not necessarily correlate with the place of injury.

Graph 14



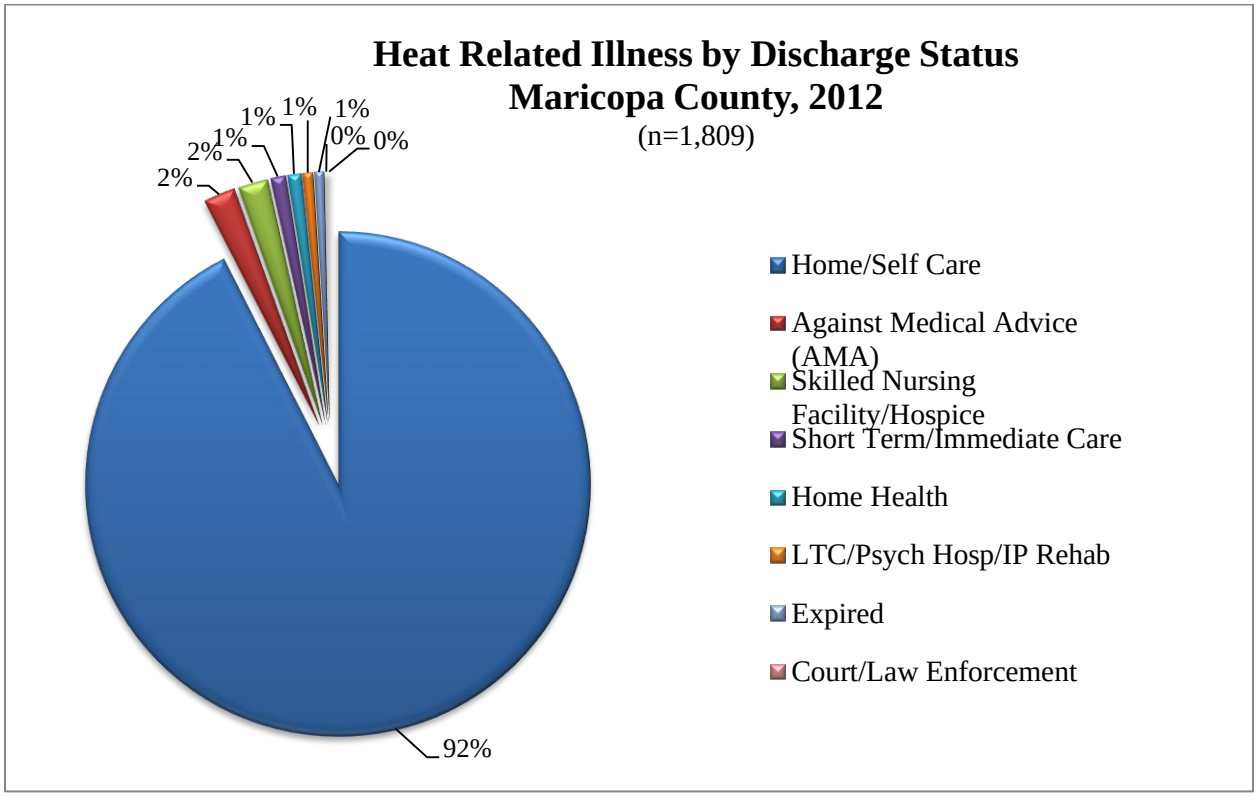
In 2012 more patients were seen for heat related illness in the Emergency Department (78%) than In-patient (22%).

Graph 15



For patients admitted to the hospital for heat related illness, 73% required hospitalization for 1-3 days and 12% of patients required 7 or more days of hospitalization. The median length of stay was two days.

Graph 16



After being seen in the hospital for heat related illness (either in the Emergency Department or In-patient), the majority of discharged statuses for 2012 were 'Home/Self Care' (92%).

Limitations

While the HDD provides valuable information regarding heat related illnesses in Maricopa County, it has some limitations. Reviewing hospital discharge data is a retrospective surveillance method and does not provide real-time updates about the current state of HRI in the county which restricts the public health response to a heat related event. There are also numerous differences in ICD-9 coding used by facilities and providers and HRIs may also be described using various keywords for the same condition making it difficult to accurately obtain true HRIs. Additionally, the time it takes to review Hospital Discharge Data (HDD) for patients with multiple admissions and to ensure that certain cases meet the case definition for HRI can be quite extensive.

Conclusions

The number of hospital visits due to heat-related illnesses in 2012 was consistently higher in the summer months, and most commonly seen amongst males age 25-64. Highlights of the analysis include:

Highlights of the analysis include:

- In 2012, June-August made up 73% of all heat related illnesses, with the month of August experiencing the highest percent of heat related illness (30%).
- More males experienced heat related illness compared to females, with a ratio of 2.4:1, males to females. As well as, a higher proportion of males were seen in-patient, than females.
- The highest number of hospital visits due to HRI occurred in those aged 20-34 years of age
- While the total count of HRIs is highest among White individuals, the rate of HRI per 100,000 population is highest amongst Blacks.
- The majority of all HRI visits were the result of a recreational or sport activity.
- A large portion of HRI occurred in a home and most patients were discharged from hospital care to a home or other self-care entity.
- Of those patients that were required to stay in-patient, over half of them had a length of stay of 1-3 days; however some patients were admitted for longer than a week.

Despite its limitations, hospital discharge data is a very useful tool for heat morbidity surveillance in Maricopa County. The volume of cases that can be reviewed from facilities across the county and the amount of data from each case that can be collected is very useful, especially for gathering information about potential risk factors for HRI. Future outreach efforts to mitigate the effects of HRI could be tailored to different areas based on the characteristics of cases seen at the various facilities.

This data is also very useful for long-term heat morbidity surveillance. The data is very thorough and can be analyzed for an array of factors over a long period of time for the entire county. Even though it cannot provide real-time data, it can show changes over time from year to year.

APPENDIX

2012 Tables

Table 1. Heat Related Illness by Month and Visit Type, Maricopa County, 2012

Month	Visit Type				Total	
	ED		IP			
		Col %		Col %		Col %
January	2	0.14	1	0.25	3	0.17
February	12	0.85	0	0	12	0.66
March	23	1.62	3	0.76	26	1.44
April	84	5.92	10	2.54	94	5.2
May	145	10.24	36	9.16	181	10.01
June	316	22.27	95	24.17	411	22.72
July	282	19.92	88	22.39	370	20.45
August	420	29.66	119	30.28	539	29.8
September	107	7.54	36	9.16	143	7.9
October	18	1.27	4	1.02	22	1.22
November	6	0.42	1	0.25	7	0.39
December	1	0.07	0	0	1	0.06
Total	1416	100.00	393	100.00	1809	100.00

Table 2. Heat Related Illness by Age Group and Month, Maricopa County, 2012

Month	Age Group							
Frequency Percent	0-4	5-19	20-34	35-49	50-64	65-74	75+	Total
January	0 0.00	0 0.00	1 0.06	0 0.00	1 0.06	1 0.06	0 0.00	3 0.17
February	0 0.00	2 0.11	3 0.17	6 0.33	1 0.06	0 0.00	0 0.0	12 0.66
March	0 0.00	7 0.39	6 0.33	4 0.22	2 0.11	4 0.22	3 0.17	26 1.44
April	3 0.17	14 0.77	24 1.33	15 0.83	21 1.16	9 0.50	8 0.44	94 5.2
May	2 0.11	16 0.88	62 3.43	42 2.32	36 1.99	12 0.66	11 0.61	181 10.01
June	4 0.22	42 2.32	133 7.35	95 5.25	82 4.53	29 1.6	26 1.44	79 4.36
July	5 0.28	35 1.93	110 6.08	107 5.91	66 3.65	20 1.11	27 1.49	370 20.45
August	4 0.22	56 3.10	161 8.90	142 7.85	115 6.36	38 2.1	23 1.27	539 5.85
September	1 0.06	20 1.11	42 2.32	27 1.49	32 1.77	13 0.72	8 0.44	143 7.9
October	0 0.00	3 0.17	5 0.28	7 0.39	5 0.28	1 0.06	1 0.06	22 1.22
November	0 0.00	2 0.11	1 0.06	1 0.06	1 0.06	2 0.11	0 0.00	7 0.39
December	1 0.06	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	0 0.00	1 0.06
Total	20 1.11	197 10.89	548 30.29	446 24.65	362 20.01	129 7.13	107 5.92	1809 100

Table 3. Heat Related Illness by Gender and Visit Type, Maricopa County, 2012

Gender	Visit Type		Total	
	ED	IP	N	%
Female	458	71	529	29.24
Male	958	322	1280	70.76
Total	1416	393	1809	100.00

Table 4. Heat Related Illness by Age Group, Gender, and Visit Type, Maricopa County, 2012

Age Group	Sex				All
	F		M		
	Visit Type		Visit Type		
	ED	IP	ED	IP	
	N	N	N	N	N
0-4	9	0	11	0	20
5-19	77	1	106	13	197
20-34	130	6	344	68	548
35-49	120	9	232	85	446
50-64	76	16	171	99	362
65-74	26	16	57	30	129
75+	20	23	37	27	107
All	458	71	958	322	1809

Table 5. Heat Related Illness by Age Group and Visit Type, Maricopa County, 2012

Age Group	Visit Type		Total	
	ED	IP	N	%
0-4	20	0	20	1.11
5-19	183	14	197	10.89
20-34	474	74	548	30.29
35-49	352	94	446	24.65
50-64	247	115	362	20.01
65-74	83	46	129	7.13
75+	57	50	107	5.92
Total	1416	393	1809	100.00

Table 6. Heat Related Illness by Race/Ethnicity and Visit Type, Maricopa County, 2012

Race/Ethnicity	Visit Type		Total	
	ED	IP	N	%
American Indian	51	12	63	3.48
Asian/NHPI	19	5	24	1.33
Black	127	33	160	8.84
Hispanic	354	83	437	24.16
White	858	255	1113	61.53
Unknown	7	5	12	0.66
Total	1416	393	1809	100.00

Table 7. Heat Related Illness by Activity Type and Visit Type, Maricopa County, 2012

Type of Activity	Visit Type		Total
	ED	IP	
No Activity Listed	1136	323	1459
walking & running	88	10	98
water & water craft	13	2	15
climbing, rappelling, & jumping off	6	1	7
dancing & other rhythmic movement	3	0	3
other sports & athletics - individual	34	10	44
other sports & athletics - team or group	35	1	36
other specified sports & athletics	3	0	3
other cardiorespiratory exercise	2	0	2
other muscle strengthening exercises	2	1	3
personal hygiene & household maintenance	12	0	12
food preparation, cooking & grilling	1	0	1
property & land maintenance, building & construction	41	20	61
animal care	1	0	1
Other activity	31	19	50
Unspecified activity	8	6	14
Total	1416	393	1809

Table 8. Heat Related Illness by Source of Admission and Visit Type, Maricopa County, 2012

Source of Admission	Visit Type		All
	ED	IP	
	N	N	N
Non-Health Care Facility Point of Origin	1406	377	1783
Transfer from a Hospital (different facility)	1	9	10
Clinic	5	1	6
Transfer from another Health Care Facility	1	4	5
Court/Law Enforcement	2	1	3
Information not available	1	1	2
All	1416	393	1809

Table 9. Heat Related Illness by Length of Stay, Maricopa County, 2012

Length of Stay	Total
Same Day	19
1-3 Days LOS	285
4-6 Days LOS	41
7+ Days LOS	48
Total	393

Table 10. Heat Related Illness by Discharge Status and Visit Type, Maricopa County, 2012

Source of Discharge	Visit Type				Total	
	ED		IP			
	No.	%	No.	%	No.	%
Home/Self Care	1372	96.89	302	76.84	1674	92.54
AMA	22	1.55	15	3.82	37	2.05
Skilled Nursing Fac.	2	0.14	25	6.36	27	1.49
Home Health	2	0.14	14	3.56	16	0.88
Short Term Fac.	9	0.64	5	1.27	14	0.77
Expired	1	0.07	10	2.54	11	0.61
Psych Hosp	4	0.28	5	1.27	9	0.50
Hospice-Facility	0	0	7	1.78	7	0.39
Court/Law Enforcement	1	0.07	3	0.76	4	0.22
Intermediate Care Fac.	2	0.14	2	0.51	4	0.22
IP Rehab	0	0	2	0.51	2	0.11
Other HC	1	0.07	1	0.25	2	0.11
LTC Hosp	0	0	1	0.25	1	0.06
Home w/Hospice	0	0	1	0.25	1	0.06
Total	1416	100.00	393	100.00	1809	100.00